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ABSTRACT

Reported is a course that has been developed in North Carolina to incorporate the history of science into a ninth grade television physical science instructional program. It follows the model which Klopfer describes as "the election of the historical approach as the organizing principle for a whole science course, or for major segments of it." Units incorporated in the course were selected and adopted with the historical approach in mind. One of the major aims of this approach is to provide the students with a view of how present day science evolved. Major emphasis is placed upon intricate relationships of various discoveries to one another. When portraying various scientists on the television screen, an attempt is made to show the nature and personality of the individual scientist. Other themes included in the televised portion of the course are: (1) the development of scientific specialization, and (2) the varied nature and conditions of scientific discovery. The historical approach to science is incorporated into the television lessons series in a number of ways, including a significant number of

dramatic vignetts and plays depicting important events in the lives and work of scientists. (BR)

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23 INCH GIANTS

SCIENCE HISTORY IN TELEVISED INSTRUCTION

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Introduction

"If I have seen further than other men, it is by standing on the shoulders of giants." Newton (6:171)

Few intellectual giants in the history of science have reached the stature of Isaac Newton. Yet, from a vantage point far above his colleagues, he recognized and expressed with thoughtful insight his dependence upon the scientific heritage on which he built. In one simple sentence was described the evolution of scientific development and the nature of the scientific enterprise. In what better way could a true feeling for science be conveyed to students than to provide them with an opportunity to look in on some of these giants and see them climbing to the shoulders of their predecessors in search of an extended view?

As the North Carolina State Department of Public Instruction sought methods for making a sudden, dramatic impact upon the quality of junior high school science instruction throughout the state, consideration was given to possible methods by which the existing statewide educational television network could be used. Emphasis was placed upon procedures by which the full potential of the television medium could be utilized while, at the same time, methods used were consistent with good science instruction. From this exploration, there evolved a comprehensive instructional system of which television is a part.(3) Among the primary considerations in the planning were methods by which science history could be employed to provide students with cognitive and affective insights into the nature of science and the scientific enterprise.

Careful planning was essential since, to be effective, the use of history cannot be just an incidental part of science instruction. "The casual mention of a great scientist's name, of the years of his birth and death, and of his accomplishments, or the mere recital of a historical event is practically worthless for realizing the insights into science that the history of science provides. The inclusion of the history of science in science teaching must be planned as carefully as the use of any other instructional materials."(2) Or, put another way, as planning is done one must satisfactorily answer the question "do these bits of history provide a feeling for the growth of science - or are they merely other facts to be memorized among the great number of facts that are thrown at the student in any science course?"(1)

The teaching strategy for incorporating the history of science into the North Carolina ninth grade television physical science instructional program follows the model of what Klopfer describes as "the election of the historical approach as the organizing principle for a whole science course, or for major segments of it."(2) In this particular course, units have been selected that adapted well to this type of approach.

Putting the Plan to Work

How, then, can television, science history, and science instruction be effectively combined? An example would be helpful.

Basic to the study of physical science is a knowledge of matter. The first unit in this course explores the intricacies of the structure and energy of the atom. On television screens throughout the state, exploration of this subject is introduced by the image of the Greek philosopher Democritus as he observes, wonders, and thinks. Why has the ring on his finger worn away without his noticing the departure of its parts? What occurs as the cobblestones on the path become rounded or the engraved latch on the door becomes smooth? When his garments become wet from the summer rains, how do they become dry again? He can see the water enter them. But, by what means does it leave? He wonders. Could it be that all matter is made up of tiny particles that cannot be seen? He takes a piece of clay and begins to divide it in half again and again. Soon he has particles so small that he cannot divide them any more. Is it possible that all matter is made of tiny particles that can neither be seen nor divided any further? Again, he wonders.

The Latin poet Lucretius is then seen as he writes about these invisible particles and spins such phrases as:

> Cloaths become moist, wch we on shoars display;
> Spread in the Sun, again, they dry appear:
> But neither how that humour entred there
> Can we perceive: nor by what means it flies
> The heat so soon, and consequently dries.
> Therefore that which is humid separates
> By minute parts, which no eye penetrates.
> Thus at the bare return of sundry years
> The ring which one upon his finger wears
> Diminisheth: Drops which do oft distill,
> Hollow hard stones; And whilst the field we till,
> The Coulter of the Plough is lessened:
> . . . . . .
>
> Nature with bodies then unseen to the eye
> All things doth manage; not that I suppose
> Nature with Bodies do's each thing inclose
> On every side, for there's a Voyd in things
> Which rightly to conceive, much profit brings.(15:73,74)

But the same kind of sound logic and observation that leads to thinking about matter being made of tiny particles, also points toward other conclusions that appear equally obvious. And so, students recognize this conflict as they see Aristotle rebuking the absurdity of tiny particles and, instead, making reasonable observations to support the belief that all matter is, indeed, made of earth, air, fire and water.

Or, at times, logic leads in other directions as is illustrated by a view of Gassendi accepting the belief that all matter is made of tiny

particles but having to speculate upon hook-like mechanicsms to provide the means for holding these particles in a solid shape.

It is the move toward scientific experimentation and the gathering of meaningful data during the seventeenth and eighteenth centuries that leads John Dalton to "see further" and formulate an atomic theory based upon scientific experimentation. As students view, during a televised lesson, a dramatization of the highlights of Dalton's life, they come to see the significance of the application of his own insights into the interpretation of information that a number of experimenters had contributed.

And so, the evolution continues with glimpses of the characters and accomplishments of such giants as J. J. Thomson, Rutherford, Bohr, Planck, and others who contributed to the modern view of the nature of matter and the structure of the atom. And with it, students from throughout an entire state grow, not only in their knowledge of the atom but also in their perception of what science really is.

Numerous other examples could be cited to illustrate the types of televised presentations that are employed. Studies of atomic radiation and nuclear energy are developed through encounters with Roentgen, Becquerel, Fermi and others. The study of electricity is ushered into the classrooms of the state through televised characterizations of Galvani, Volta, Oersted, Faraday, Benjamin Franklin, Joseph Henry, and numerous other contributors to electrical theory and technology. Explorations into electronics and communications bring students into contact with the personalities and accomplishments of Fleming, DeForest, Edison, Morse, Marconi, and Alexander Graham Bell.

And so, the list could continue. But throughout this development, the message and goal is always two-fold. Along with the view of scientists, inventors, and scientific development comes important concepts and information about scientific theories and principles.

Additional Areas of Emphasis

In accomplishing these two major objectives, a number of important factors are given particular attention. The following are examples of some of these.

1. The interrelationship of scientific discoveries.

   As has already been described in considerable detail, one of the major aims of this approach is to provide the students with a view of how present day science evolved. Major emphasis is placed upon intricate relationships of various discoveries to one another. Attention is drawn to major breakthroughs in scientific theory that met delay for years until minor pieces of a giant puzzle were arranged into place.

2. The humanization of the image of scientists.

When portraying various scientists on the television screen, the nature and personality of the individual is often given as much or more attention as is directed toward his scientific achievements. The purpose is to alter the stereotyped view that many students have of the type of individuals who excel in scientific endeavors.

To be sure, some are eccentric. These are often the ones that students hear about and upon whom they shape their impressions. But there are many more who live normal lives and who have strong humanistic and humanitarian interests and commitments. Efforts are made to portray a balance of these characteristics and to present scientists as real human beings.

3. The development of scientific specialization.

Through an examination of individuals who contributed to the growth of science, it soon becomes apparent that as scientific knowledge has expanded and become increasingly complex, contributions to its development have come from individuals who have devoted increasingly larger proportions of their time to increasingly narrower segments of its total scope.

Even into the last century, significant contributions to science were made by people who dabbled in it as a hobby or sideline. Philosophers, poets, monks, statesmen, artists, and ministers all added significant links to the chain of scientific progress. Some worked in a wide range of fields of science.

Now, however, it is increasingly common for professional scientists to devote their entire lives to an extremely narrow specialty within one area of science. Through televised incidents in the history of science, an effort is made to convey this phenomenon to the students.

4. The varied nature and conditions of scientific discovery.

The history of science provides a wealth of fascinating stories concerning the sometimes bizarre circumstances under which important scientific discoveries have been made. Through portraying the historical development of science on television, special efforts are made to put this type of event into proper perspective. For example, what may appear to the young junior high school student to be a chance or lucky discovery is, when appropriate, presented as evidence to support Pasteur's observation that "chance favors the prepared mind." Emphasis is placed upon the years of study and exploration that lead to the "lucky accidents."

Examples of these sudden insights are balanced by portraying other instances where discovery follows a more normal course of systematic exploration and observation. Opportunities are provided to observe scientific developments as they evolve from a broad spectrum of circumstances including individual

perserverance, methodical study, serendipitous discovery, scholarly insights, and the sudden culmination of years of self-discipline and hard work. Examples are also drawn from a variety of working conditions ranging from the situations and resources of poverty-stricken, lonely plodders to those of well financed, highly trained research teams.

Approaches to Providing Historical Information

The historical approach to science is incorporated into the televised lesson series in a number of ways. Most significant of these are dramatic vignettes and plays depicting significant events in the lives and work of scientists. Most of these are prepared by the television production staff. However, students in classes utilizing the course have become interested in participating in these presentations and have produced, and presented on the air, plays about highlights in the careers of such scientists as Galileo, Newton, Benjamin Thompson, Joseph Henry, and George Washington Carver.

However, television is only a portion of the total instructional system in this course and, although it lends itself to dramatic presentations, still other media are incorporated to provide students with contact and insights into science history. One of the most effective of these is references to paperback books that are accessible to students and that provide both interesting and informative reading.(6 to 31)

Evaluation

The critical question is, as always, does this type of approach do any good. Do students who are pursuing this method in their science study really achieve a significantly higher degree of understanding of science?

In a comprehensive evaluation of the use of this televised course, comparisons were made with control classes not employing television. Measurements were made in a variety of areas. Among the instruments employed was the Test on Understanding Science.(5) In the area of this test in which differences were found to be significant, students taking the course using television achieved the higher scores. Furthermore, there was no evidence that this benefit was gained at the sacrifice of any of the other goals of the course.(4)

Summary

As students of ninth grade physical science in North Carolina pursue their studies, a wide range of resources are available to them. Included among these are a series of televised lessons available over the statewide

educational television network. In addition to inquiry into the methods, processes, and procedures of science and extensive opportunities for experimentation and equipment manipulation, there is, interwoven into the fabric of the televised lessons and the related course, a continuous historical thread spun from the varied fibers of scientists and scientific discoveries that entwine to construct the warp and woof of the scientific enterprise.

Perhaps, among those who explore this evolution of scientific growth, there will be those who will seek a firm foothold that will enable them to climb to strong shoulders so that they might peer, even further, into the distant unknown.

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